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Frequency and phase synchronization in neuromagnetic cortical responses to flickering-color stimuli

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Abstract

In our earlier study dealing with the analysis of neuromagnetic responses (magnetoencephalograms-MEG) to flickering-color stimuli for a group of control human subjects (9 volunteers) and a patient with photosensitive epilepsy (a 12-year old girl), it was shown that Flicker-Noise Spectroscopy (FNS) was able to identify specific differences in the responses of each organism. The high specificity of individual MEG responses manifested itself in the values of FNS parameters for both chaotic and resonant components of the original signal. The present study applies the FNS cross-correlation function to the analysis of correlations between the MEG responses simultaneously measured at spatially separated points of the human cortex processing the red-blue flickering color stimulus. It is shown that the cross-correlations for control (healthy) subjects are characterized by frequency and phase synchronization at different points of the cortex, with the dynamics of neuromagnetic responses being determined by the low-frequency processes that correspond to normal physiological rhythms. But for the patient, the frequency and phase synchronization breaks down, which is associated with the suppression of cortical regulatory functions when the flickering-color stimulus is applied, and higher frequencies start playing the dominating role. This suggests that the disruption of correlations in the MEG responses is the indicator of pathological changes leading to photosensitive epilepsy, which can be used for developing a method of diagnosing the disease based on the analysis with the FNS cross-correlation function.

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